Changing Employers Cognition: Personal Mobile Technology as a Workplace Enabler for Blind and Visually Impaired Workers

Research-in-Progress

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Abstract

Most employers believe blind and visually impaired people (BVIP) cannot perform essential job tasks and require expensive accommodation. The emergence of smartphones, enabling applications, screen readers, and Internet access provide a personal assistive mobile technology (PAMT) bundle which dramatically extends sensory capabilities for BVIP. PAMT should afford new workplace capabilities. However, the promise of these capabilities has not yet been accounted for by job-skill trainers, employers or policymakers. We articulate a theoretically informed model of task capabilities fit to account for the enhanced capabilities of PAMT-enabled BVIP. We offer our model as a diagnostic tool to help employers, vocational rehabilitation agencies, and policy makers evaluate the utility of these capabilities in various organizational settings and distribute resources in a more efficient way. We introduce experimental and exemplary demonstrations as a means of assessing the goodness of our model and disseminating information regarding these new BYOD capabilities into the workplace.

Keywords: ICT, blind and visually impaired people, task capability fit, employability

Introduction

Information Systems (IS) research lives at the confluence of organizations, information technology (IT) and individuals. As a domain of study, IS research is concerned with theories and practices related to the social and technological phenomena which shape organizational use of IT and consequent effects on organizations and society (Ward and Peppard 2002). One of the more enduring challenges in IS research is how organizations can best leverage IT to enable workers and engage them in accomplishing the ambitions of the firm. Perhaps there is no community for whom the enabling potential of IT plays a more pivotal role than for blind and visually impaired persons (BVIP). BVIP comprise a special population whose employment is often contingent on the availability of enabling IT and adaptive technologies (UNCRPD 2008). This research promises to develop rich data around the fit between organizations, IT, and BVIP whose reliance on the enabling potential of technology far exceeds that for sighted people.

According to the World Health Organization (2010), more than 285 million people in the world are BVIP. Of these, over 20 million reside in the U.S. (AFB 2014). Approximately 38% of the working-age BVIP in
the U.S. are fully or partially employed, while 62% are unemployed or not seeking work (Erickson et al. 2014). Why is employment among BVIP so low? A 2012 survey of hiring managers and corporate decision makers sponsored by the National Industries of the Blind (NIB) finds the majority of managers believe there are few jobs in their organizations which can be performed by BVIP (Lynch 2013). However, the United Nations Convention on the Rights of People with Disabilities (UNCRPD) finds employers often fail to appreciate the extent to which BVIP are able to work as effectively as normally-sighted colleagues in a wide range of industrial, commercial, managerial and professional jobs when appropriate enabling technology is made available (UNCRPD, 2008, Article 27 section 2.2). The UNCRPD calls for action to promote employability of BVIP and highlights the critical role enabling IT plays in increasing their employability and expanding the range of jobs for which they might qualify.

In the last decade, the rise of smartphones and enabling applications has dramatically impacted the quality and kind of enabling IT available to BVIP (AFB 2014). Taken together, smartphones, enabling apps, built-in screen readers and internet connectivity comprise a personal assistive mobile technology (PAMT) bundle that afford BVIP new capabilities to interact with their environment (Parker, 2013). Yet the capabilities of PAMT-enabled blind jobseekers (PBJ) are not yet accounted for in the employment calculus of managers, corporate decision makers or vocational rehabilitation (VR) specialists (Lynch, 2013; Charlene Guggisberg, Director Blind Inc., personal communication, 8/29/2015; Dave LoPresti, CEO Industries of the Blind Greensboro, personal communication, 7/20/2015; Rick Stephens, Director, The Association of Blind and Visually Impaired, personal communication, 7/9/2015). Tony Stephens, public policy specialist at NIB, says he is challenged to imagine anything he cannot do now as a consequence of his blindness, noting: “mobile technology has caught up to the point that it can essentially be our eyes. Now the challenge is to break down the barriers in other people’s minds” (Parker 2013). How can we, as IS researchers, answer the UNCRPD call for action and break down these barriers to help organizations learn to account for the workplace potential of PBJ?

This research explores two questions which bear on the issue of employability and workplace utilization of PBJ: 1) Will increased awareness of PBJ capabilities impact the perceived utility of PBJ to employers?, and if so, 2) How can awareness of PBJ capabilities be effectively disseminated to potential employers? We believe this research is a necessary first step to reduce the systemic workplace disenfranchisement of BVIP and help them overcome management (mis)perceptions to take their rightful place in industry.

**Background and Theory**

**Apps for BVIP**

Mobile technologies and enabling applications are profoundly reshaping the way in which BVIP can interact with the physical world. For example, the K-NFB Reader app, developed collaboratively by Ray Kurzweil and the National Federation of the Blind, allows BVIP smartphone users to snap pictures of printed text on any nearby surface and hear that text read aloud (Farr, 2014). Leveraging pattern recognition software and the image-processing technology built in the smartphone, K-NFB users can read menus, browse classroom handouts, read instructions, watch PowerPoint presentations, and perform other task that were previously daunting or impossible. TapTapSee, a subscription-based smartphone application, allows subscribers to snap photographs of anything in their vicinity and submit them for human visual interpretation. Descriptions of the content of the photos are texted back to the submitter seconds later. In an early interview for this project, an interviewee described how TapTapSee allows her to understand the labels in her children's clothes (who are sighted) and color coordinate their clothes for school. She recollects how going to the freezer to select something for dinner prior to owning this app was a game of “freezer surprise”. However, now she is able to quickly identify the content of every package. LookTel’s Money Reader app uses the camera built in any smartphone to identify the denomination of paper money. Increasingly, smartphones are an eye for the blind. PAMT afford the user new ways of understanding and interacting with their environment.

According to the New York Times, advocates for BVIP perceive PAMT as the biggest assistive aid since the invention of Braille in the 1820s (Bilton 2013). They imbue BVIP with new and powerful capabilities. Organizations that strive to empower BVIP, including the NIB, NFB and AFB are particularly excited about the iPhone, with its’ built in screen reader and myriad enabling applications. Our extensive review of literature on apps for BVIP (485 apps in different categories), reveals that they extend the functional
capabilities of BVIP in a number of ways. With careful analysis, we have identified the following new capabilities which might have utility in the workplace.

<table>
<thead>
<tr>
<th>New Capability</th>
<th>Description</th>
<th>Representative Apps</th>
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<tr>
<td>Recognize object visually</td>
<td>Identify objects in surroundings, understand their appearance</td>
<td>TapTapSee, LookTel Recognizer, VizWiz</td>
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<td>Detect color</td>
<td>Identify precise color of an object</td>
<td>Color ID, ColorVisor</td>
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<td>Detect sources of light</td>
<td>Identify light sources such as open doors, luminous bulbs</td>
<td>Light Detector</td>
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<td>Read non-electronic printed text</td>
<td>Read printed text from paper or other surfaces in surroundings</td>
<td>K-NFB Reader, Text Detective, Text Grabber</td>
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<td>Detect denomination of paper money</td>
<td>Identify denominations of currency</td>
<td>LookTel Money Reader, TapTapSee</td>
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<tr>
<td>Location awareness</td>
<td>Get geographic information, such as street address, points-of-interest</td>
<td>Ariadne GPS, BlindSquare, AroundMe</td>
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<tr>
<td>Interpret barcodes, QR codes</td>
<td>Identify products and retrieve product information from barcodes</td>
<td>QR Reader, RedLaser, DigitEyes, CamFind</td>
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<tr>
<td>Create audio labels</td>
<td>Create QR code labels and associate them with self-recorded audio files</td>
<td>Digit-Eyes</td>
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<tr>
<td>Read digital content</td>
<td>Access online reference material</td>
<td>Read2Go, Voice Dream Reader, BARD mobile</td>
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Table 1. PAMT-enabled capabilities of the PBJ

Employment of BVIP

Unemployment levels among BVIP remains significantly high in spite of VR support, anti-discrimination laws, and incentives for employers. Traditionally, BVIP prepare for, secure and retain employment with the help of VR agencies (Chan et al. 2010). VR agencies provide educational/vocational training and support to prepare a client for employment. They offer job placement assistance as she looks for a job. Once secured, the agencies contact employers to discuss accommodations and provision appropriate assistive technologies. Employers who hire BVIP receive tax credits and other government incentives. Legal regimes are available in the developed world to govern the hiring of people with disabilities, including BVIP. For instance, the Americans with Disabilities Act (ADA) requires that employers (with 15 or more employees) provide reasonable accommodations to qualified workers with disabilities provided it does not cause undue hardship. However, it remains uncertain whether reasonable accommodation requirements would extend to PAMT, as “an employer does not have to provide as reasonable accommodations personal use items to accomplish daily tasks on and off the job” (Commission 2002).

Strangely, passage of the ADA has seen a decline in the employment rate of people with disabilities (Stapleton et al. 2004). Among BVIP, less than 30% of working age adults are employed (NIB 2014), the majority of whom work at organizations serving the blind (McDonnall et al. 2015). Negative employer attitude is considered a major contributor to the unemployment problem (Crudden and McBroom 1999; Crudden et al. 2002; Kirchner and Harkins 1997). Both VR professionals and BVIP clients cite negative employer attitude as an ongoing problem (McDonnall et al. 2015). A majority of employers believe it would be difficult to hire BVIP for positions that commonly become available in their organizations (Gilbride et al. 2000; Inglis 2006). They believe BVIP cannot perform most job tasks, and that they need expensive job accommodations (Kwoh 2013; Lynch 2013). Employers remain oblivious to the fact that BVIP can function effectively at the workplace utilizing assistive technologies, adaptive techniques, and environmental adjustments (McDonnall et al. 2014).

We believe, based on our research, that PAMT can dramatically extend the capabilities of PBJ and directly impact the jobs and task for which they might qualify. However, knowledge of these capabilities has not yet diffused into the curriculum of job skill trainers or employers. We interviewed multiple job skill trainers of BVIP in the U.S. Midwest on this question. None of these trainers could identify any training...
program on the use of PAMT in the workplace. Charlene Guggisberg, the program director at Blind Inc., the organization at the forefront of smartphone training for BVIP in the Midwest clarified "Our iPhone skills training is quite dynamic; we tailor training to meet the specific demands of clients from different backgrounds. But, our training does not cover using smartphones to perform job tasks." There is strong evidence in the HR literature and from our own investigation that managers’ perceptions regarding the workplace capabilities of BVIP is under-informed, and that this is especially true for PBJ.

**Task Capabilities Fit**

PAMT are powerful assistive technologies self-supplied by the PBJ. They have the two-fold potential to lower managers’ expectation regarding the cost of accommodation while increasing expectations of worker potential. We argue that increasing managerial perceptions of PBJ capabilities can impact their perceived utility in the workplace. We cast the challenge as one of unrecognized fit between a PBJ and the task requirements of the roles for which they might be considered.

Considerable attention has been paid in the IS literature to fit in the context of IT adoption (Venkatesh et al. 2003). Task technology fit (TTF) is a well-researched theory within this stream which argues the impact of fit as a determinant of performance outcomes and utilization of a technology (Goodhue and Thompson 1995). Fit refers to the degree to which a technology provides features and capabilities that match the requirements of the task it must support. Tasks are broadly defined as the technology-supported activities of the user in converting inputs to outputs. Technologies are computer systems (hardware, software and data) and user support services (training, help resources, etc.) used by individuals in accomplishing tasks. Individuals are the users of technology whose individual characteristics, such as training and motivation, can impact how well the technology can be leveraged. TTF represents “the correspondence between task requirements, individual abilities, and the functionality of the technology” (p. 214).

We adapt our concept of fit from the theory of TTF to model how increased awareness of PBJ capabilities might improve managers’ perceptions regarding their fit with the tasks they might perform within the organization. We work from the assumption that PAMT are supplied by the job-seeker rather than the organization. Therefore, fit must be evaluated based on the capabilities embodied by the BVIP/PAMT dyad rather than in the technology itself. Theories on technology affordance and constraint, entanglement, adaptive structuration, imbrication, and others make a strong case that the capabilities of the user/technology dyad better reflect the performance potential of a technology-enabled worker than when technology and user are studied separately. We define perceived fit as managerial perception of the match between the technology-enabled capabilities of the PBJ and the tasks associated with the role for which they are being considered (see figure 1). We propose that increased awareness of PBJ capabilities will impact perceived fit. The TTF literature supports the notion that greater fit leads to greater perceived utility and likelihood of utilization. We propose greater perceived fit will increase perceived utility of PBJ.

**Viability**

Managerial concerns about the cost of accommodating BVIP raise the issue of viability. Why should managers consider hiring a BVIP if the cost of supporting them will be higher than for a sighted worker with similar skills? A number of studies in the m-commerce literature address the issue of viability in the context of technology adoption (Liang and Wei 2004; Liang et al. 2007; Tjan 2001). Tjan (2001) argues that viability must be considered, along with fit, as an appropriate determinant of utility. Viability is evaluated using available quantitative data about the likely payoff of utilizing a technology. Liang et al. (2009) extend this logic to model viability as a measure of the organization’s culture and values, economic feasibility and suitability of the current IT infrastructure of the firm. Utility is argued to be higher if there is sufficient support for the mobile technology along these dimensions. We adopt the concept of viability from the m-technology adoption literature and propose that increased awareness regarding PBJ capabilities will impact managers’ perception of viability, and that greater perceived viability will increase perceived utility of the PBJ.

HR literature indicates the majority of BVIP who are employed work for agencies which serve BVIP (McDonnall et al. 2015). These organizations are often described as “blind-friendly”. Their culture and values support the inclusion or advancement of BVIP. We define organizational support as the degree of
management support and advocacy for BVIP, and propose that the degree of organizational support impacts the perceived viability of PBJ.

Economic feasibility is concerned with cost/benefit analyses. In the case of the PBJ, the cost is arguably no different than for a sighted applicant. PBJ bring their own PAMT. However, managers do not currently see this (Lynch, 2013). They believe accommodating BVIP involves extra cost. They are challenged to evaluate the capabilities and limitations of PBJ in pecuniary terms. We propose that economic feasibility of employing PBJ impacts perceived viability.

We define IT Infrastructure as the network connectivity required for PBJ to access the Internet in the workplace. PAMT is not designed to integrate with the IT of the organization. Therefore, “guest” access to Wi-Fi would be sufficient to avoid the cost associated with data use for the PBJ. We propose that the suitability of the current IT infrastructure to support PBJ impacts viability.

**Conceptual Model**

The conceptual framework, shown in figure 1, illustrates the constructs described in the prior section. Perceived fit is a measure of managers’ perceptions of the match between the characteristics of task and PBJ capabilities. Perceived viability is a measure of managers’ perceptions of the degree of organizational support, economic feasibility and IT Infrastructure support for PBJ. Perceived fit and perceived viability impact perceived utility of PBJ. We articulate this theoretically-informed model to conceptualize the problem domain regarding managerial cognition toward the PBJ, and to help address the first research question: *Will increased awareness of PBJ capabilities impact the perceived utility of PBJ to employers?*

![Figure 1 – Conceptual Model of Task Capabilities Fit](image)

**Methodology**

In this study, we will present managers with evidence regarding the capabilities of PBJ and evaluate how this evidence impacts their perceptions along the dimensions of our model. In order to craft our intervention, we turn to dissemination science. Dissemination science explores how evidence-based research can best be evaluated and communicated to an inter-organizational societal sector of potential adopters and implementers to produce effective results (Dearing, 2009). Dissemination science methods have been applied by social workers, agricultural scientists, healthcare providers, government agencies, and academic researchers in a variety of disciplines to help bridge the gulf between evidence-based academic research and practice. Research in dissemination science suggests demonstration as one of the most powerful means of spreading new technologies, information, policies or practices (Centola and Macy 2007; Valente and Davis 1999). We turn to demonstration as a means of presenting managers with evidence regarding the capabilities of PBJ workers, adopting the idiom that “seeing” is believing.
Demonstrations take two general forms; experimental and exemplary. Experimental demonstrations allow experimentation regarding how to present a promising intervention. Exemplar demonstrations, on the other hand, showcase one which is proven (Myers 1978). Experimental demonstrations are field tests conducted “not just for the formative improvement of an intervention, but more fundamentally to the determination of whether a particular innovation should be diffused, or not” (Dearing 2009). In this research, we will employ experimental demonstration to test our first research question: Will increased awareness of PBJ capabilities impact the perceived utility of PBJ to employers? We will conduct interviews with managers before and after the experimental demonstration to learn how their perceptions of PBJ are impacted along the dimensions of our conceptual model. If the results of the experimental demonstrations are shown to positively impact managerial perceptions regarding fit, viability and utility of PBJ, we will then recast the demonstration into the exemplar form as a tool for demonstrating the capabilities of PBJ to other organizations. This will allow us to evaluate the benefit of exemplary demonstrations with regard to the second research question: How can awareness of PBJ capabilities be effectively disseminated to potential employers?

Context of Study

The National Industries of the Blind (NIB) are an umbrella organization comprised of over 150 affiliate agencies. Collectively, they are the largest employers of BVIP in the U.S. The NIB is actively engaged in helping BVIP develop careers in “challenging, knowledge-based positions in high-energy quality work environments” (NIB 2014). Affiliates of the NIB sell SKILCRAFT® and other products and services to federal customers through the AbilityOne federal government purchasing program, which requires federal agencies to preferentially source purchases from community-based nonprofit agencies dedicated to training and employing individuals with disabilities – all other factors being equal. We have established a working relationship with management at multiple affiliate agencies of the NIB in this and prior studies. Agencies contracting with AbilityOne are expected to assist workers in obtaining referrals to other organizations for employment. Consequently, agencies of the NIB are change agents capable of disseminating information on PBJ capabilities into the workplace.

We chose the Industries of the Blind-Greensboro (IOB-G) as the initial affiliate with whom to conduct our experimental demonstration. They are an opinion leader within the NIB network. They are very familiar with issues surrounding the employability of BVIP, and are amenable to exploring interventions intended to improve their employability. Preliminary interviews with management indicate they have not yet considered the potential impact of PAMT in the workplace. An informal survey found approximately 60% of IOB-G’s BVIP workers own and regularly use smartphones outside work. However, the current IOB-G policy prohibits the use of smartphones in the production environment, the conference room, and other work spaces due to their potential to distract workers.

Design of Experimental Demonstration

In this research-in-progress, we develop and present an experimental demonstration to IOB-G management. We conduct pre- and post-demonstration interviews to assess the impact of the demonstration on managers’ perceptions regarding the roles and tasks for which PBJ can be utilized. In the full research to follow, we will use lessons learned at IOB-G to create an exemplar demonstration to the IOB-Milwaukee, and other similar-sized NIB affiliate with similar attributes. At each of these sites the presentations will be tailored to showcase PBJ capabilities contextualized to the specific tasks of the firm.

Participants for the IOB-G study include the CEO, his assistant, the CIO, the HR manager, the production manager, and a line employee in manufacturing. The CEO has considerable prior experience as a rehabilitation specialist for BVIP. The HR manager and the line employee are both BVIP. The materials used were the iPhone 5 with iOS 8.0, VoiceOver screen reader, and two enabling apps– KNFB Reader and Digit-Eyes. KNFB affords users the ability to capture and convert text from non-electronic printed documents and other objects (i.e. bulletin board, business card, employee handbook, label, etc.) for screen-reading. Digit-Eyes affords users the ability to create QR codes, print and attach them to physical objects, and link them to self-recorded audio description. KNFB Reader and Digit-Eyes were selected in consultation with management. We asked managers to choose 2 capabilities from the ten listed in Table 1, and recommended these two apps as best-of-breed for each capability based on word-of-mouth and professional reviews.
With the help of management, we selected two BVIP workers at IOB-G who owned and were experienced in iPhone, and who would be willing to demonstrate the technology to management. The CEO indicated his rationale for choosing these two participants was based on the extra degree of trust he placed in their opinions. We installed KNFB-reader and Digit-Eyes on their personal phones and ask them to familiarize themselves with these apps at home and work for a two week period. We then tasked them with formally demonstrating the workplace potential of these apps, if any, to management. One of the presenters is the HR manager, who is a young woman in her 20’s who recently lost her sight while pursuing a bachelor’s degree in psychology. The other is a woman in her mid-30s who works as a line employee in manufacturing and has been with IOB-G for several years. Neither had prior experience with the apps selected. The presenters were invited to collaborate and coordinate their demonstration. Both indicated their enthusiasm to demonstrate the potential of PAMT to management as they wanted to have the same capabilities at work as in their everyday life.

Discussion

The pre-demonstration interview data and our own observations confirm that, as expected, there is little management understanding of PAMT or PBJ capabilities. Currently, determination of fit involves matching BVIP capabilities with the task they might perform. Tasks are designed to increase fit by crafting templates, forms and other fixtures to facilitate the work. Adaptive technology is sometimes provided to increase the range of worker capabilities. We found a high level of organizational support for BVIP among managers. IT Infrastructure is not a baseline consideration in determining the viability of a BVIP. The economic impact of hiring a BVIP absent technology is contingent on the degree of accommodation and training required. This is evaluated on a case by case basis.

The experimental demonstration involved a 25-minute presentation of PBJ capabilities to an attentive managerial audience. The presenters demonstrated how PBJ capabilities could be applied in manufacturing, HR, and other job contexts. In manufacturing, they showed how to read printed instructions typically attached to machines; identify and label storage bins and their content, and learn whether they are empty or not; and recognize parts on the shelf and where they fit in the production process based on QR coding. In HR, they described how to make employee handouts audible with QR codes; translate job interview material into candidate’s preferred language; organize paperwork (e.g., action forms, time sheets) into folders and easily locate documents when needed. They demonstrated their ability to read the employee handbook, meeting handouts, keynotes projected on the wall, and notes posted on employee bulletin board. The CEO challenged the presenters to demonstrate the readability of additional print material. After this demonstration, the CEO began verbalizing how he could reimage the processes within the organization as a means to better leverage this new set of capabilities. The following are samples of this conversation:

"I want to change the work instructions for [line worker]. I want to see what [HR manager] does and try it in different places...We need to figure out how we can consistently put QR codes on things and read them...If a few of us (sighted managers) get KNFB reader along with you, we can see how to make our documents properly so they fit with readers, which we don’t do... A QR code could be at every door that says “to get to this go 50 feet and turn left...we can see how to set up this QR code thing so that it works not only from the blind point of view, but also from the employer point of view and then we can be like a training leader for that...Cathy starts today in customer service. I’d like to get her set up. She doesn’t have a smartphone. I’d like to start showing her how we can use this thing...I want to look at all the different capabilities that can come from this platform... For you two (presenters), starting today, you can definitely use your phones all over the place. Don't worry about what anyone says. Just say you're special...The big idea is, say you're a regular organization that doesn’t already employ the blind. How do we give someone tools that they can already come with? They already have the smartphones. How can we use this technology to get them hired in other organizations? The fact that, with a few weeks of practice, [HR manager] could go to another employer and say, “I can show you how I can do this HR job. It won’t cost you a penny. I have all the tools I need.” The big deal now is if you employ somebody that’s blind you’ve got to get special computers and special this and that. This doesn’t eliminate all of that, but it eliminates the simple stuff. Do I have to buy you a scanner? No, I can take care of that. How are you going to file? I'll take care of that. We can make a strong referral because we know what she can do (using PAMT)."
Management is currently experimenting with the capabilities they observed to understand their goodness in a production environment. The CIO requested our catalog of apps so that they might identify other PBJ capabilities potentially useful for IOB-G.

**Conclusion**

In this RIP, we have articulated a theoretically informed model of task capabilities fit to account for the enhanced capabilities of blind or visually impaired workers who bring their own personal assistive mobile technology. We offer the model as a diagnostic tool to help organizations, rehab specialists and policy makers evaluate the employability of PBJ in various organizational settings and distribute resources in a more efficient way. Page limitations prevent us from presenting our complete findings interpreted through our model. However, we conclude by saying we found strong evidence to support our model, and that increased awareness of PBJ capabilities can impact managerial perceptions of PBJ utility in the organization, at least in high BVIP support settings. We have illustrated how experimental and exemplary demonstrations can be linked with pre- and post- assessment to address our research questions and link our task capabilities fit theory back to practice. We believe exemplary demonstrations will enable us to disseminate information regarding PBJ capabilities into the workplace and positively impact PBJ utilization and employment. The topic of using technology to assist with disabilities is not a common one in our literature, but one that is engaging and could have a meaningful societal impact. We look forward to discussing our findings in more detail at the conference.

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